**Male facial attractiveness, dominance, and health and the interaction between cortisol
and testosterone**

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Abstract

Objectives The dual-hormone hypothesis suggests that associations of testosterone (T) with certain behavioral tendencies are stronger when cortisol (C) levels are low simultaneously. A range of studies provided supporting evidence for TxC interaction effects for example on dominance and risk-taking behaviors. However, concerning perceptions of facial characteristics the evidence is mixed, with a recent study reporting a positive association between perceived facial dominance and T among men with higher C.

Methods We sought to further examine links of observer-rated facial attractiveness, dominance and health (based on photographs of $N = 165$ men) with baseline T, competition-induced T reactivity, and their interaction with baseline C.

Results There was some evidence that baseline T and the interaction of T reactivity with baseline C positively predicted facial dominance, however these were not robust when including control variables.

Conclusions Since no effects were found for attractiveness and health, our results suggest that associations of perceived facial characteristics with baseline T, T reactivity and their interactions with baseline C are rather weak.

Keywords: testosterone, cortisol, faces, attractiveness, dominance, health

Introduction

From an evolutionary perspective, it is essential for humans to acquire mates and to reproduce (Puts, 2016). To attract potential mates, men and women must signal their value as a sexual partner. One mechanism involved in acquiring mates is the endocrinological system. Hormones act as coordinators within the human body, affecting morphology, cognition and behavior (Roney, 2016). For males, the steroid hormone testosterone (T) plays a key role in mating and intrasexual competition. High T levels have been associated with elevated mating effort (Archer, 2006), offspring protection (van Anders, Goldey, & Kuo, 2011) and development of secondary sexual characteristics such as muscle tissue and body hair (Vermeer, Riečanský, & Eisenegger, 2016). Men with high baseline T show more aggressive and dominant behavior (meta-analysis: $k = 42$ samples, overall $N = 9760$, Archer, Graham-Kevan, & Davies, 2005; $N = 69$, Sellers, Mehl, & Josephs, 2007; 2 studies, overall $N = 151$, Mehta & Josephs, 2010) and are rated as higher in extraversion and self-disclosure by observers ($N = 99$, Roney, Lukaszewski, & Simmons, 2007). Such behavioral tendencies are often inferred from an individual's facial characteristics, which are crucial cues in social interactions. For example, humans preferably interact with partners who have symmetric and average faces, assumingly because they are expected to be healthy and fit (for a review, see Little, Jones, & DeBruine, 2011). It has been suggested that women also detect facial cues of men's hormonal concentrations and use these to assess mate attractiveness ($N = 39$ male stimuli, $N = 29$ female raters, Roney, Hanson, Durante, & Maestripieri, 2006). Men's T levels are positively linked with women's ratings of facial attractiveness ($N = 74$ male stimuli, $N = 94$ female raters, Rantala et al., 2012; Roney et al., 2006), dominance (2 studies, $N = 50$ male stimuli, overall $N = 68$ male and female raters, Penton-Voak & Chen, 2004; Roney et al., 2006), and may be related to health (as suggested by the immunocompetence handicap hypothesis, Folstad & Karter 1992; Foo et al., 2017).

Still, several studies found only weak associations of T with facial attractiveness and dominance. Penton-Voak and Chen (2004) used constructed and real male faces with high and low T levels ($N = 50$) and found no evidence for links between T and observer-rated attractiveness ($N = 40$ male and female raters), contrary to the above-cited studies. Similarly, Neave, Laing, Fink, and Manning (2003) found that among female ratings ($N = 36$) of facial photos of male college students ($N = 48$), T was not linked with attractiveness or dominance. Whereas Swaddle and Reiersen (2002) found no direct link between T and observer-rated facial attractiveness, females did rate men with high T as higher in facial dominance ($N = 21$ male stimuli, $N = 50$ raters). One factor that might explain inconsistent and weak associations is that rather than baseline T, effects may be stronger for T reactivity, an acute increase in T levels, such as when engaging in a competition or mating opportunity (Archer, 2006). Carré and Olmstead (2015) proposed that individual differences in behavior and traits may be more reliably related to T reactivity than to baseline T. Lefevre, Lewis, Perret, and Penke (2013) investigated the association between male baseline T levels and T reactivity with facial width-to-height-ratio (fWHR, study 1: $N = 185$ men, study 2: $N = 92$ men), an objective measure supposedly mapping facial dominance. They found that fWHR was associated positively with T reactivity in the one study in which it was included, and baseline T in only one of the two studies. However, a later meta-analysis found these associations to be non-robust ($k = 9$ samples, $N = 1041$, Bird et al., 2016). If not objectively-measured facial traits, observer-perceived facial attractiveness and dominance may still be related to T reactivity. If these relationships turn out to be robust, it would further support a role of acute T increases modulating behaviors and traits related to mate acquisition and intrasexual competition as suggested earlier (e.g., Archer, 2006; Roney, 2016).

A second explanation which has been proposed for weak links between traits and T is a buffering effect of the steroid hormone cortisol (C). Mehta and Josephs (2010) showed that

across two studies (study 1: $N = 94$ men and women, study 2: $N = 57$ men), high baseline T was positively linked with observer-rated trait dominance only when baseline C levels were low simultaneously (in a leadership and competition context). For individuals with high C levels, the relationship between T and dominance was either non-significant or reversed (Mehta & Josephs, 2010). Consequently, they proposed interacting effects of baseline T and baseline C (TxC interaction) on dominance-related behaviors and traits, termed the *dual-hormone hypothesis* (Mehta & Josephs, 2010; for a review, see Mehta & Prasad, 2015). Rantala and colleagues (2012) found that facial photos of men ($N = 74$) were rated as higher in attractiveness when their baseline T levels were high and C low simultaneously ($N = 94$ female raters). Facial dominance was also positively associated with baseline T only when C was low (Penton-Voak & Chen, 2004). Conflicting evidence was provided by Kandrik and colleagues (2017), who investigated the baseline TxC interaction in association with perceptions of facial attractiveness, health and dominance. Seventy-three male and female participants rated five facial photos each of 45 heterosexual men (overall 225 facial photos). Whereas they found no effects of baseline T, baseline C or their interaction on health or attractiveness ratings, dominance ratings correlated with the TxC interaction. However, in contrast to the dual-hormone hypothesis and previous findings, men with high T were rated as higher in facial dominance only when simultaneously C levels were high. Thus, the exact direction and robustness of effects of TxC interactions on perceived facial dominance, attractiveness and health remain unclear.

Moreover, recent studies have found moderating influences of a prominent facial characteristic, beardedness, on perceptions of attractiveness and dominance in men. Beards have been suggested to be sexually selected, potentially being functional as threat displays in intrasexual competition (e.g., Puts, Bailey, & Reno, 2015). In several studies, effects of men's beardedness on perceptions of their facial attractiveness, dominance and health were shown (e.g., $N = 10$ men in four shaving conditions each, $N = 528$ male and female raters, Dixson &

Brooks, 2013; $N = 36$ men in four shaving conditions each, $N = 8520$ female raters, Dixon, Sulikowski, Gouda-Vossos, Rantala, & Brooks, 2016). Accordingly, in our study we examined our results' robustness by including beardedness as well as relationship status, age and BMI as control variables.

Aims and hypotheses

In this study, we aimed to replicate and further investigate associations of men's baseline T, competition-induced T reactivity, also in interaction with baseline C, with observer-ratings of facial attractiveness, dominance and health. We hypothesized (1) high baseline T and (2) T reactivity to be positively linked with ratings of facial dominance, attractiveness and health. In line with the dual-hormone hypothesis, we hypothesize associations of (3a) baseline T and (4a) T reactivity with facial dominance, attractiveness and health to be attenuated by higher baseline C levels. Considering the findings of Kandrik and colleagues (2017), alternatively the faces of men with (3b) higher baseline T and (4b) higher T reactivity may be perceived as more attractive, dominant and as healthier when C levels are simultaneously high.

Methods

Participants. One hundred sixty-five heterosexual men participated in the study (mean age = 24.3 years, $SD = 3.25$, range = 18-34), of which 125 belonged to an experimental and 40 to a control group. From the participants, 90.4% were students (of which only two were enrolled as psychology students). None of the participants indicated to be taking any hormonal supplements or medication. All procedures received ethics approval from the Georg-Elias-Müller-Institute of Psychology's Ethics Committee (no. 111).

Procedure. Our study was divided into a pre- and a main session. The pre-session was led by a male experimenter. Participants provided informed consent and information on their relationship status and age. Anthropometric measures (body height using a stadiometer and

weight using a digital scale, from which BMI was calculated), a first saliva sample (for baseline testosterone (T) and cortisol (C) measures) and standardized facial photographs were taken (and further measures not relevant to this study, for details see Kordsmeyer & Penke, 2017). For the latter, participants stood in front of a white wall, directly faced the camera and were asked to show a neutral facial expression. Two photos were taken for each participant and the more suitable photo (regarding neutral expression and head angle) was chosen for the subsequent rating study. The main session was conducted a few days later and participants first provided a saliva sample for second baseline T and C measures and filled in questionnaires not relevant for this study (see Kordsmeyer & Penke, 2017). In the experimental group, pairs of men engaged in a dyadic competition (four disciplines, mixture of cognitive and physical games, such as arm wrestling and table pinball soccer game, see Kordsmeyer & Penke, 2017), while being supervised by an attractive female confederate. Both the competition and exposure to the attractive confederate were carried out to elicit a T response. The female confederate was told to interact naturally with the participants, while providing some verbal encouragement. Instead, in the control group, participants watched a neutral documentary video for the duration of the competition (ca. 12 mins, SFM Canada, 2013) and the procedure was led by a man, in order not to trigger T reactivity. Immediately after the competition or watching the documentary, and again 15-20 minutes later, participants provided a saliva samples to measure T reactivity, and filled in further questionnaires not relevant here (see Kordsmeyer & Penke, 2017). Both sessions were held between 2pm and 6pm to control for diurnal variation in hormonal levels (Idris, Wan, Zhang, & Punyadeera, 2017; Stanton & Schultheiss, 2009).

Hormonal samples. For each sample, participants provided at least 2ml of saliva via passive drool through a straw (Fiers et al., 2014; Schultheiss, Schiepe, & Rawolle, 2012), which were immediately stored at -80°C. Afterwards, saliva samples were shipped on dry ice to the Technical University of Dresden and analyzed for T and C levels using chemiluminescence

immuno-assays with high sensitivity (IBL International, Hamburg, Germany). The intra- and inter-assay coefficients (CVs) are below 8% for C and below 11 % for T. Outliers were winsorized to three *SDs* ($n = 8$ in the experimental, $n = 1$ in the control group, in accordance with Mehta, Welker, Zilioli, & Carré, 2015). All participants were asked to not drink alcohol, exercise, take recreational or non-prescribed clinical drugs on the day of the study, to not ingest caffeine or sleep three hours before, and to not smoke, brush their teeth or drink (except for water) one hour before their appointment. Adherence to these instructions were assessed with a screening questionnaire (Stanton & Schultheiss, 2009; for further details, see Kordsmeyer & Penke, 2017). Because all T and C measures were positively skewed and violated the assumption of normality (Shapiro-Wilk test statistics $< .94$, $ps < .001$), all variables were log10-transformed (e.g., Mehta et al., 2015). For baseline T, we aggregated the two baseline measures to get a more reliable measure (e.g., Idris et al., 2017). T reactivity was calculated as difference scores, for the two post-competition samples separately (baseline T values from the main session subtracted from post-competition levels, Lobbestael, Baumeister, Fiebig, & Eckel, 2014; Roney, Lukaszewski, & Simmons, 2007). Finally, we excluded one participant from the experimental condition due to missing data for baseline T and C (decreasing sample size to overall $N = 164$, and $n = 124$ for T reactivity).

Rating study. Facial photos of 164 target men (one photo was excluded due to issues with the photograph) were presented on computer screens in randomized order. Eleven male participants (age: $M = 23.2$ years, $SD = 3.0$, range 19-29) rated facial dominance (item: “How dominant is this man?”) and health (“How healthy is this man?”) on 11-point Likert-scales (dominance: $-5 =$ “extremely submissive” to $+5 =$ “extremely dominant”, health: $-5 =$ “extremely unhealthy” to $+5 =$ “extremely healthy”). Twelve female participants (age: $M = 25.2$ years, $SD = 7.1$, range 19-44) rated facial short-term attractiveness (item: “How sexually attractive is this man?”) and long-term attractiveness (“How attractive is this man for a long-

term relationship?") on 11-point Likert-scales (for both: -5 = "extremely unattractive" to +5 = "extremely attractive"). The raters first previewed all facial photos for 0.5 secs each. Additionally, for each target man raters were asked to what degree they knew him on a 3-point scale (1 = "not at all", 2 = "know him by sight", 3 = "well"). Data points where a rater indicated to know a given target man well (= 3) were excluded from subsequent analyses. Interrater agreements were high (Cronbach's $\alpha > 0.79$, see Table 1). Since mean ratings for short- and long-term attractiveness were highly correlated ($r = .95$), the average was used ("mean attractiveness"). To control for target men's beardedness, three trained, independent coders (two female, age range 18-29 years) judged the beardedness of all targets on a 11-point Likert-scale (0 = "clean-shaven", 10 = "longest, fullest beard", $\alpha = .92$), which were averaged to a beardedness variable.

Statistical analyses. Regression analyses were used to investigate effects of T, C and their interaction on facial ratings, separately for baseline T (one model) and T reactivity (two models for the two reactivity measures). Predictors were T levels (baseline T or T reactivity), baseline C, and TxC interactions. Analyses for baseline T were run on the full sample ($N = 163$) with the mean of the two baseline measurements. Analysis for T reactivity were run on the experimental group only ($n = 124$), since only in this group the experimental condition was aimed to elicit a T response. In these models, the baseline C measure from the main session was used, because T reactivity measures were taken on this day. For robustness checks, we ran two separate regression models, firstly including target men's coded beardedness as a covariate, secondly including age, BMI and relationship status (1 = single/open relationship, 2 = committed relationship/engaged/married) as covariates, the latter because being in a romantic relationship has been found to attenuate T levels in men (e.g., van Anders & Watson, 2006).

Data availability. The data and analysis script associated with this research are available at osf.io/65tz4.

Results

Descriptive statistics for all main variables and bivariate correlations between facial ratings can be found in Tables 1 and 2, respectively.

Table 1

Descriptive statistics of all main variables.

	<i>M</i>	<i>SD</i>	Cronbach's α
Age	24.3	3.3	
BMI	23.98	3.81	
Beardedness	2.59	2.29	.92
Baseline cortisol	0.45	0.21	
Baseline testosterone	1.89	0.15	
1 st testosterone reactivity	0.05	0.12	
2 nd testosterone reactivity	0.08	0.14	
Facial dominance	0.56	1.28	.79
Mean facial attractiveness	-1.35	1.43	.86/.87 ^a
Facial health	0.51	1.39	.84

Note: $N = 124$ -164; ^ashort-/long-term attractiveness; Cronbach's α = interrater agreement (intercoder agreement for beardedness); baseline cortisol/testosterone: mean of two measures, log10-transformed and winsorized.

Table 2

Pearson correlations between facial ratings.

	Mean Attractiveness	Health
Dominance	.24**	.39***
Mean attractiveness		.56***

$N = 164$; ** $p < .01$, *** $p < .001$.

For facial dominance, there was a significant positive main effect of baseline T ($\beta = 0.47$, $SE = .17$, $p = .048$, $\eta^2 = .04$; TxC interaction: $p = .10$; for detailed results, see Table 3), which was robust when controlling for beardedness, as well as when controlling for relationship status, age and BMI (Tables S1-S2). No further significant effects of baseline T, C or their

interaction on facial dominance, attractiveness or health were found (all unsigned β s<1.65, p s>0.10; Table 3).

Table 3

Regression models of baseline TxC interaction, baseline T and baseline predicting rated facial attractiveness, dominance and health.

	β	SE	t	p	Partial η^2
Facial attractiveness					
Baseline T	0.19	0.18	1.10	.27	.01
Baseline C	-0.05	0.96	-0.05	.96	.00
Baseline TxC	-0.13	1.01	-0.13	.90	.00
Facial dominance					
Baseline T	0.47	0.17	2.72	.048	.04
Baseline C	1.41	0.95	1.48	.14	.01
Baseline TxC	-1.64	1.00	-1.64	.10	.02
Facial health					
Baseline T	0.10	0.18	0.56	.58	.00
Baseline C	0.56	0.99	0.56	.57	.00
Baseline TxC	-0.57	1.04	-0.55	.58	.00

Note: $N=164$; T = testosterone; C = cortisol; for each aggregate measures from two samples; partial η^2 = partial eta-squared effect size.

Table 4

Regression models of the T reactivity x baseline C interaction, T reactivity and baseline predicting rated facial attractiveness, dominance and health (experimental group only).

	1st T reactivity					2nd T reactivity				
	β	SE	t	p	Partial η^2	β	SE	t	p	Partial η^2
Facial attractiveness										
T reactivity	-0.15	0.14	-1.11	.27	.01	-0.08	0.14	-0.54	.59	.00
Baseline C	-0.15	0.11	-1.37	.17	.02	-0.14	0.11	-1.24	.22	.01
T react. x baseline C	0.25	0.15	1.68	.10	.02	0.27	0.14	1.87	.06	.03
Facial dominance										
T reactivity	-0.34	0.14	-2.48	.01	.05	-0.23	0.14	-1.63	.11	.02
Baseline C	-0.16	0.11	-1.47	.14	.02	-0.17	0.11	-1.54	.13	.02
T react. x baseline C	0.32	0.15	2.16	.03	.04	0.36	0.14	2.51	.02	.05
Facial health										
T reactivity	-0.20	0.14	-1.49	.14	.02	-0.14	0.14	-0.97	.33	.01
Baseline C	0.03	0.11	0.24	.82	.00	0.02	0.12	0.15	.88	.00
T react. x baseline C	0.15	0.15	1.02	.31	.01	0.17	0.14	1.15	.25	.01

Note: $n=124$; 1st/2nd T reactivity = testosterone reactivity from 1st/2nd post-sample; C = cortisol; react. = reactivity; partial η^2 = partial eta-squared effect size.

In the experimental group, a negative main effect of T reactivity (for the 1st T reactivity sample only: $\beta = -.34$, $SE = .14$, $p = .01$, $\eta^2 = .05$; 2nd: $\beta = .23$, $p = .11$; Tables 4) on facial dominance was detected. This negative main effect of T reactivity was attenuated by high baseline C levels (T reactivity x baseline C interaction, for both T reactivity samples, 1st: $\beta = 0.32$, $SE = .15$, $p = .03$, $\eta^2 = .04$; 2nd: $\beta = .36$, $SE = .14$, $p = .027$, $\eta^2 = .05$, Table 4; Fig. 1). These effects were robust in both control models, except for the effect of the T reactivity x baseline C interaction for the first T reactivity sample when controlling for age, BMI and relationship status ($p = .06$; Tables S3-S4). No further effects of T reactivity or its interaction with baseline C were found on men's facial dominance, attractiveness or health in either of the T reactivity models (all unsigned $ps > .06$; Table 4). Effects of the control variables can be found in the supplementary (Tables S1-S4).

Fig. 1 Interaction between baseline cortisol and testosterone reactivity (panel A/B: first/second testosterone reactivity measure) on ratings of facial global dominance.

Discussion

The goal of this study was to investigate whether baseline testosterone (T) and competition-induced T reactivity, also in interaction with baseline cortisol (C), are associated with observer-

ratings of men's facial attractiveness, dominance and health. The faces of men with higher baseline T were rated as more dominant, the effect of which was robust in two control models (including target men's beardedness as well as relationship status, age, and BMI). T reactivity was positively related to rated facial dominance when baseline C was high simultaneously (for both T reactivity measures), in line with a recently reported finding by Kandrik and colleagues (2017), but inconsistent with the dual-hormone hypothesis (e.g., Mehta & Josephs, 2010). Still, the TxC interaction effect was at least partly robust in the two control models. No further effects of baseline T, T reactivity, baseline C or any interactions on observer-rated attractiveness, dominance or health were detected.

The resulting positive association between men's baseline T and observer-perceived facial dominance is in line with other studies (Penton-Voak & Chen, 2004; Roney et al., 2006). Still, we could not replicate earlier findings on associations between baseline T and facial attractiveness or health (e.g., Rantala et al., 2012; Rhodes, Chan, Zebrowitz, & Simmons, 2003; Roney et al., 2006; Penton-Voak & Chen, 2004). Our null-findings for effects of baseline T on health and attractiveness ratings converge with some former studies (Kandrik et al., 2017; Neave et al., 2003; Penton-Voak & Chen, 2004). Furthermore, besides an unexpected negative association between T reactivity and facial dominance we did not find effects of T reactivity on facial ratings, suggesting that at least for perceptions of facial characteristics associations may not be stronger for T reactivity than for baseline T (cf. Carré & Olmstead, 2015).

Following the dual-hormone hypothesis, perceived facial characteristics such as dominance, attractiveness, or health may only be positively related to T when C levels are low (Mehta & Prasad, 2015). In contrast, Kandrik and colleagues (2017) recently showed a different pattern. Ratings of facial dominance were positively related to baseline T among men with higher baseline C levels. In our study, we partly replicated their finding, in that the association of facial dominance with T reactivity was attenuated by low baseline C levels. However, we

did not find an interacting effect for baseline T, leaving unresolved the question whether baseline T or T reactivity is more reliably associated with men's facial dominance, moderated by baseline C. In case either of these interacting effects can be replicated in subsequent studies and turn out to be robust, this hints at the possibility that C might not have a buffering but rather an enhancing effect on T. It has been suggested that C augments energy mobilization not only in threatening or stressful situations, but may also play a role in mating contexts, potentially facilitating mating effort (Jaremka & Collins, 2017; Van der Meij, Buunk, Salvador, 2010). Even though we did not find effects for facial attractiveness, the association for facial dominance, which is assumed to be functional in signaling to male rivals (Hill, Bailey, & Puts, 2017), may mean that the combination of high T reactivity and simultaneously high baseline C levels is implicated in intrasexual competitive and/or mating situations. Since it has been stated that so far mechanisms of a TxC interaction can only be speculated about (e.g., Mehta & Prasad, 2015), findings like ours and Kandrik and colleagues' (2017) stress the necessity of further investigating the exact neurophysiological origin of such an endocrinological interaction, and the exact directions of relationships between TxC and different traits and behaviors.

Generally, the many non-significant effects of baseline T, T reactivity and their interactions with baseline C raise the question to what extent hormones are related to signaling mate qualities and/or formidability via physical appearance and to what extent observers are able to detect hormonal cues from faces (Roney et al., 2006). Since the dual-hormone hypothesis was stated for behavioral measures and findings of associations between baseline T and behavior have been more consistent (Archer et al., 2005; Mehta & Josephs, 2010; Mehta & Prasad, 2015; Popma et al., 2007; Roney et al., 2006; Sellers et al., 2007), it is possible that hormone levels are not as strongly linked with physical appearance as they are with behavior. Alternatively, some of our findings may represent false negatives, potentially explicable by overall small effect sizes, which despite our comparatively large sample would benefit from

even more statistical power. Therefore, it would be of interest to investigate hormonal effects in even larger samples, especially when considering the previously mixed and partly contrasting findings. Future research should also focus on associations between hormones and ratings of female faces; some first studies have already provided some promising results (Gonzalez-Santoyo et al., 2015; Rantala et al., 2013).

To conclude, we provide some further evidence for associations of hormone levels, and especially an interaction between testosterone and cortisol, with observer-perceptions of men's facial characteristics, but also provide further evidence of no associations for others. Relationships were found for facial dominance, but not attractiveness or health. These findings are in line with a recent study by Kandrik and colleagues (2017), in that T predicted facial dominance when C was high. Hence, they further question the previously reported direction of this interaction as suggested by the dual-hormone hypothesis. Our study paves exciting avenues for future research on hormonal associations, especially interactions between testosterone and cortisol, with not only facial, but also other traits and behaviors implicated in mating and competition.

Conflict of interest. On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Supplementary material

Table S1

Regression models of baseline TxC interaction, baseline T and baseline predicting rated facial attractiveness, dominance and health, including the covariate beardedness.

	β	SE	t	p	Partial η^2
Facial attractiveness					
Baseline T	0.18	0.17	1.06	.29	.01
Baseline C	-0.05	0.94	-0.06	.96	.00
Baseline TxC	-0.13	0.99	-0.13	.90	.00
Beardedness	-0.22	0.08	-2.96	.004	.05
Facial dominance					
Baseline T	0.48	0.17	2.81	.006	.04
Baseline C	1.42	0.94	1.50	.13	.01
Baseline TxC	-1.64	.99	-1.66	.10	.02
Beardedness	0.16	0.08	2.15	.03	.03
Facial health					
Baseline T	0.11	0.18	0.61	.55	.00
Baseline C	0.56	0.98	0.57	.57	.00
Baseline TxC	-0.57	1.03	-0.55	.58	.00
Beardedness	0.13	0.08	1.68	.10	.02

Note: $N=164$; T = testosterone; C = cortisol; for each aggregate measures from two samples; partial η^2 = partial eta-squared effect size.

Table S2

Regression models of baseline TxC interaction, baseline T and baseline predicting rated facial attractiveness, dominance and health, including the covariates relationship status, age and BMI.

	β	SE	t	p	Partial η^2
Facial attractiveness					
Baseline T	0.22	0.17	1.29	.20	.01
Baseline C	0.40	0.93	0.43	.67	.00
Baseline TxC	-0.62	0.98	-0.64	.52	.00
Relationship status	-0.09	0.16	-0.55	.58	.00
Age	-0.22	0.08	-2.91	.004	.05
BMI	-0.21	0.08	-2.73	.007	.05
Facial dominance					
Baseline T	0.45	0.17	2.63	.001	.04
Baseline C	1.10	0.95	1.16	.25	.01
Baseline TxC	-1.30	1.00	-1.31	.19	.01
Relationship status	0.00	0.16	0.01	.99	.00
Age	0.16	0.08	2.10	.04	.03
BMI	0.14	0.08	1.82	.07	.02
Facial health					
Baseline T	0.13	0.17	0.78	.44	.00
Baseline C	0.79	0.93	0.84	.40	.00
Baseline TxC	-0.81	0.98	-0.83	.41	.00
Relationship status	0.17	0.16	1.06	.29	.01
Age	-0.04	0.08	-0.53	.60	.00
BMI	-0.37	0.08	-4.88	<.0001	.13

Note: $N=164$; T = testosterone; C = cortisol; for each aggregate measures from two samples; partial η^2 = partial eta-squared effect size.

Table S3

Regression models of the T reactivity x baseline C interaction, T reactivity and baseline predicting rated facial attractiveness, dominance and health, including the covariate beardedness (experimental group only).

	1st T reactivity					2nd T reactivity				
	β	<i>SE</i>	<i>t</i>	<i>p</i>	Partial η^2	β	<i>SE</i>	<i>t</i>	<i>p</i>	Partial η^2
Facial attractiveness										
T reactivity	-0.18	0.14	-1.34	.18	.01	-0.11	0.14	-0.78	.44	.01
Baseline C	-0.17	0.11	-1.51	.13	.02	-0.16	0.11	-1.41	.16	.02
T react. x baseline C	0.28	0.15	1.89	.06	.03	0.30	0.14	2.12	.04	.04
Beardedness	-0.19	0.09	-2.15	.03	.04	-0.19	0.09	-2.18	.03	.04
Facial dominance										
T reactivity	-0.31	0.13	-2.29	.02	.04	-0.19	0.14	-1.41	.16	.02
Baseline C	-0.15	0.11	-1.37	.17	.02	-0.16	0.11	-1.40	.16	.02
T react. x baseline C	0.29	0.15	1.99	.049	.03	0.32	0.14	2.30	.02	.04
Beardedness	0.20	0.09	2.21	.03	.04	0.20	0.09	2.22	.02	.04
Facial health										
T reactivity	-0.18	0.14	-1.30	.20	.01	-0.11	0.14	-0.77	.44	.01
Baseline C	0.04	0.11	0.35	.73	.00	0.03	0.11	0.29	.77	.00
T react. x baseline C	0.12	0.15	0.85	.40	.01	0.13	0.14	0.94	.35	.01
Beardedness	0.18	0.09	2.03	.04	.03	0.18	0.09	2.04	.04	.03

Note: $n=124$; 1st/2nd T reactivity = testosterone reactivity from 1st/2nd post-sample; C = cortisol; react. = reactivity; partial η^2 = partial eta-squared effect size.

Table S4

Regression models of the T reactivity x baseline C interaction, T reactivity and baseline predicting rated facial attractiveness, dominance and health, including the covariates relationship status, age and BMI (experimental group only).

	1st T reactivity					2nd T reactivity				
	β	<i>SE</i>	<i>t</i>	<i>p</i>	Partial η^2	β	<i>SE</i>	<i>t</i>	<i>p</i>	Partial
Facial attractiveness										
T reactivity	-0.19	0.13	-1.41	.16	.02	-0.07	0.14	-0.51	.61	.00
Baseline C	-0.22	0.11	-2.00	.048	.03	-0.19	0.11	-1.70	.09	.02
T react. x baseline C	0.31	0.14	2.13	.04	.04	0.30	0.14	2.18	.03	.04
Relationship status	-0.09	0.18	-0.52	.60	.00	-0.06	0.18	-0.31	.76	.00
Age	-0.18	0.09	-1.90	.06	.03	-0.17	0.09	-1.84	.07	.03
BMI	-0.21	0.09	-2.36	.02	.05	-0.24	0.09	-2.62	.01	.06
Facial dominance										
T reactivity	-0.31	0.14	-2.28	.02	.04	-0.22	0.14	-1.57	.12	.02
Baseline C	-0.12	0.11	-1.07	.29	.01	-0.14	0.11	-1.18	.24	.01
T react. x baseline C	0.28	0.15	1.88	.06	.03	0.33	0.14	2.30	.02	.04
Relationship status	-0.05	0.18	-0.29	.77	.00	0.00	0.19	-0.02	.98	.00
Age	0.14	0.09	1.54	.13	.02	0.16	0.09	1.68	.10	.02
BMI	0.14	0.09	1.50	.14	.02	0.12	0.09	1.29	.20	.01
Facial health										
T reactivity	-0.22	0.13	-1.69	.09	.02	-0.12	.13	-0.90	.37	.01
Baseline C	-0.02	0.11	-0.15	.89	.00	-0.01	.11	-0.07	.94	.00
T react. x baseline C	0.22	0.14	1.54	.13	.02	0.23	.14	1.65	.10	.02
Relationship status	0.10	0.18	0.54	.59	.00	0.13	.18	0.72	.48	.00
Age	-0.08	0.09	-0.90	.37	.01	-0.07	.09	-0.89	.43	.01
BMI	-0.36	0.09	-4.09	<.0001	.13	-0.38	.09	-4.23	<.0001	.13

Note: $n=124$; 1st/2nd T reactivity = testosterone reactivity from 1st/2nd post-sample; C = cortisol; react. = reactivity; partial η^2 = partial eta-squared effect size.